Stirling tram feasibility study – Preliminary patronage estimates

February 2010

City of Stirling/Department of Planning

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1. Introduction

1.1 Stirling Centre redevelopment

The City of Stirling, in partnership with the Western Australian Planning Commission (WAPC) has commenced a comprehensive review of the Stirling Regional Centre Structure Plan. The Stirling Regional Centre includes the Innaloo Shopping Centre, the Stirling Civic Centre precinct, Osborne Park Hospital, part of the Osborne Park industrial area, the Greater Union Theatre and some surrounding residential area.

Following extensive community consultation, a master plan has been developed which would see Stirling Centre redeveloped as a major urban centre supporting new retail, commercial, community and residential opportunities for the region (see Figure 1-1). To support this development, significant improvements in the transport system would be required and the LRT is one proposed component.

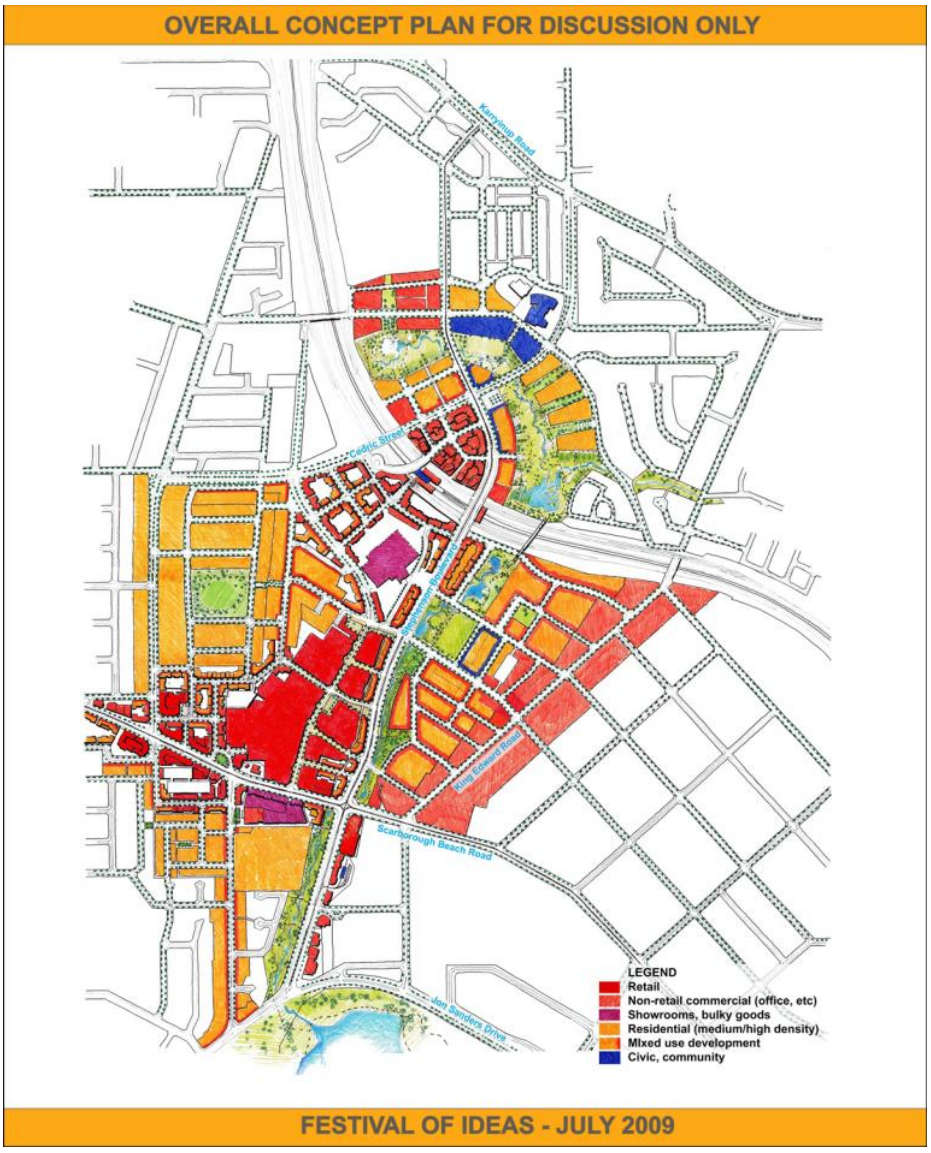

Figure 1-1: Concept master plan. http://www.stirlingcitycentre.com.au/

1.2 About this study

Parsons Brinckerhoff (PB) has been commissioned by the City of Stirling/WA Planning Commission alliance to undertake a high-level investigation into the potential patronage for a proposed tram/light rail system (LRT) for Stirling Centre.

For the purposes of this study the future Stirling Centre has been considered along with the adjacent major commercial and retail areas of Osborne Park and Glendalough. This allows for the examination of coherent transport options. The study area in its regional context is shown in Figure 1-2 below.

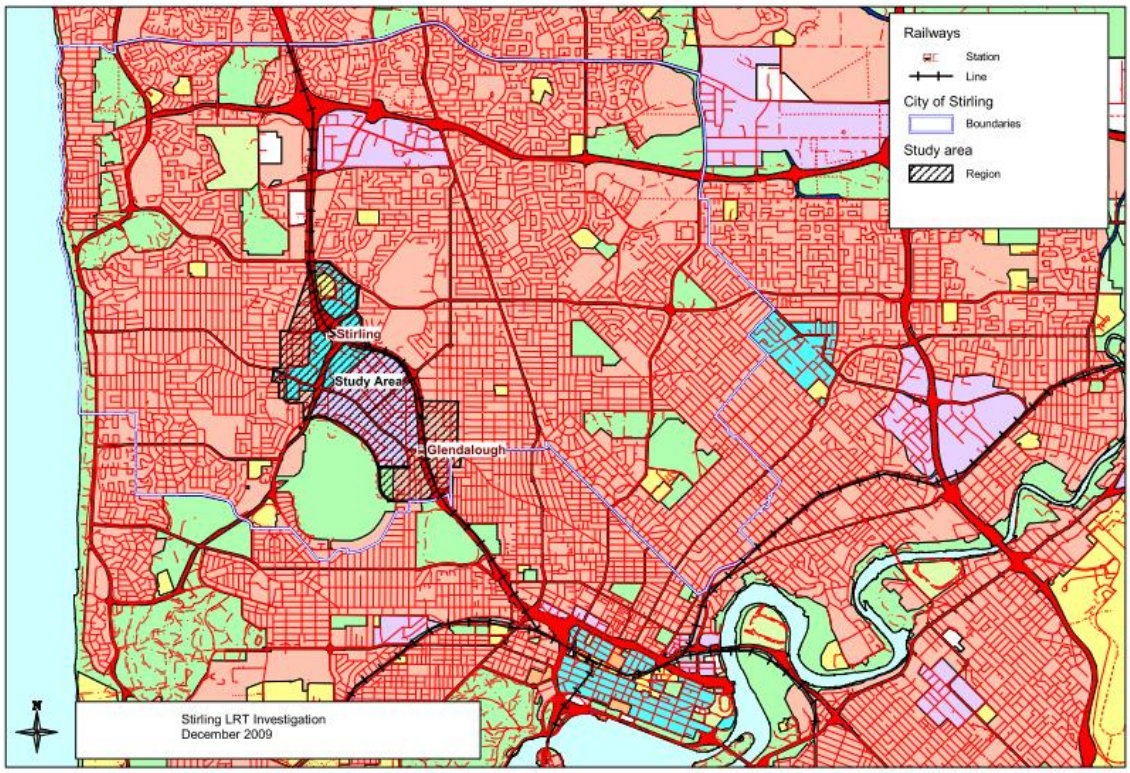

Figure 1-2: Study area in regional context

It is expected that the LRT would be constructed in phases. Phase 1 would link the Stirling train station and hospital with the major shopping centre at Innaloo, Phase 2 would run east along Scarborough Beach Road through Osborne Park to Glendalough Station. Future possible phases would include routes such as a continuation west along Scarborough Beach Road to Scarborough Beach (refer Figure 1-3).

This particular report is concerned with Phases 1 and 2.

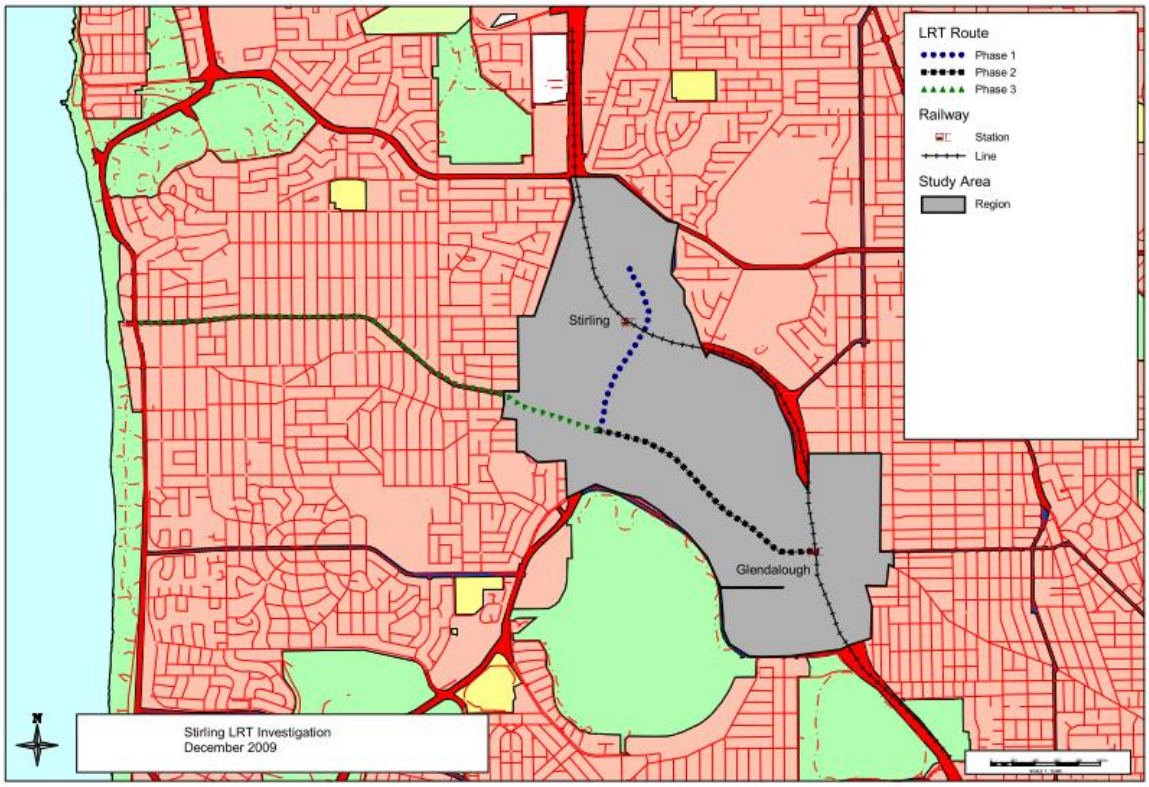

Figure 1-3: Potential LRT phasing

2. Context: the role of light rail systems

2.1 Role of light rail systems

2.1.1 Transportation

Many cities in the English speaking world removed their street-based tram systems during the 1960s when buses were seen as more modern and efficient and road networks were being expanded. However in recent years there has been a renewed interest in the potential of electric transport and a number of cities have introduced new light rail transit (LRT) systems. These systems have been popular as they provide a 'quality' transportation system which can have significant impact on a city's transportation system as well as the potential to act as an anchor for urban regeneration. Many of these examples can be found in the US in traditionally car-oriented cities similar to Perth (see Table 2-1).

Table 2-1: Performance of selected modern light rail lines

- **Houston, Texas – Metro Red Line**
  Four years after opening (Fourth quarter - 2007), the 7.5 mile first LRT line carried 40,000 riders per day, well ahead of the projected ridership of 18,000-20,000 passengers per day. The line opened in January 2004.
- **San Diego, California – Green Line**
  In September 2007, nearly 27,000 passengers per day rode the 5.9 mile extension which opened in July 2005.
- **Minneapolis, Minnesota – Hiawatha Line**
  The 12 mile initial line carried 30,100 riders per day in the Fourth Quarter of 2007. The line opened in December 2004.
- **Portand, Oregon – Yellow Line**
  The 5.8 mile LRT project, completed in 2004, carried 13,600 riders per day in May of 2007.
- **Sacramento, California – South Corridor**
  Completed in 2003, the 6.3 mile line carried 9,250 riders per day in 2007.

Research has shown that directly connecting destinations with LRT is a sound strategy for generating ridership gains. For example, the street running Houston LRT has the highest passenger density per mile of any new LRT in the US and does so by though the centre of employment districts than skirting them. This means that LRT is best placed in the core, not the edge of the desired service area, an important consideration with selecting alignments.

LRT is best suited for serving a wide variety of short trips within districts and corridors, not for serving regional commuters. Street running systems (trams) are primarily designed as local area circulators, not to serve long haul commuter trips. Along LRT corridors, station spacing is typically within relatively close proximity allowing the LRT to serve as a 'pedestrian accelerator.' It can also be described as a 'horizontal elevator', similar to a multi-floor department store, with a different purpose or function at each station. A well designed LRT route will show good two-way patronage throughout the day as it supports multiple uses, such as shopping during the day and leisure trips after hours as well as commuter trips during the peaks.

A decision to build LRT is as much, if not more, about connecting people to jobs, education, retail and cultural opportunities and stimulating economic development, as it is about the expected cost of the capital and operating expenditure. The investment in LRT infrastructure signifies the corridor as 'the place to be' for future development. It is commonly uses to catalyse truly urban transit-orientated development which is characterized by greater intensity and diversity of uses as well as less parking. The joint strategy is intended to expand the area which can support walkable urbanism. It also expands the customer base and customer access for existing businesses while improving the market value for existing properties.

2.2 Evaluation of benefits

Government decision makers and the public want to see infrastructure funds spent wisely and effectively. As a result, accurately estimating the potential ridership and economic development benefits from proposed transit improvements is paramount.

Reliable ridership modelling is also important for accurately estimating capacity needs and for maintaining public support for future transit investments. In some cases, the ridership estimates are not at issue because of underestimating the demand. A number of new LRT lines in North America are outperforming their initial ridership estimates, thus creating capacity strains such as a shortage of transit vehicles. Since transit providers are often unprepared for success, public confidence in the transit providers can decline as a result.

However, ridership is only one of several factors that should be used to evaluate the effectiveness of a new LRT. As highlighted by the Reconnecting America, 'while ridership is important, it should not be the ultimate determinant in whether a regional transit line gets built.' This is particularly important for LRT since it is primarily a tool for encouraging housing infill and economic development than for transportation. Developers are assured by the capital investment or 'rails in the street' to invest in the walking catchment of the line. The initial $56 million (US) investment in LRT for Portland, Oregon has generated over $3 billion (US) in real estate development in its service area.

Another benefit to consider regarding LRT is the 'trip not taken.' This specifically refers to the decrease in motorized trips due to more efficient transit and land use patterns that enable people to access destinations without needing to drive. While difficult to measure, there is evidence the benefit can be significant. In Portland, it is estimated that vehicle miles travelled per capita is only 9.8 VMT per day in neighbourhoods with good transit connections and mixed-use development. This compares to 21 VMT per day for most suburban areas in Portland. After constructing the Portland Streetcar and adding over 7,200 housing units along its alignment, it was calculated that these new housing units could account for a reduction of 31.7 million miles per year by car.

3. Summary of modelling approach

3.1 Basic inputs and assumptions

This report is a preliminary investigation into likely patronage of the proposed Stirling LRT. It is designed to provide sufficient information to confirm whether or not a detailed investigation of the proposal is warranted. Therefore, detailed strategic transportation modelling has not been undertaken at this stage. Instead, forecasts from the Perth Strategic Transport Evaluation Model (STEM) for 2031 have been used as a base and adjusted to account for impacts of the proposed LRT as well as proposed increased development in Stirling, Osborne Park and Glendalough.

PB was supplied with the October 2009 draft of the *Scarborough Beach Road Population & Land Use Study* prepared by Syme Marmion consultants for the Department of Planning. This has been used as the source of a 'base case' future year for the Stirling – Osborne Park – Glendalough study area. Other scenarios have also been investigated to test the sensitivity of the base case results to different inputs.

As significant development was expected for all parts of the study area, the base case transport network was assumed to include a light rail link from Glendalough to Stirling. That is to say, Phase 1 and Phase 2 of the route would be constructed. As part of the construction of the LRT, it was also assumed that there would be a major restructuring of bus routes. In particular, there would be a significant reduction in the number of buses serving Scarborough Beach Road which would be replaced with the LRT.

3.2 Modelling process

Given the level of development anticipated, Stirling City Centre together with Osborne Park will be an important destination for work, shopping and leisure trips from a large proportion of the Perth metropolitan area. To understand the potential patronage for the LRT it is essential to understand the likely demand for public transport trips from the wider metropolitan area for all trip types. As a fully multi-modal 4-stage transport model, the Perth Strategic Evaluation Model (STEM) has the ability to model transport behaviour across the Perth and Peel region. However, as a strategic model it is not sufficiently fine-grained to model accurately a short route such as the proposed Stirling tram without significant additions and reconfiguration.

Therefore, for this preliminary evaluation, STEM model outputs have been taken as a basis for a spreadsheet-based estimation of potential patronage. This provides for a more robust estimation than an approach based purely on assumptions.

The overall approach taken for estimating LRT patronage is as follows:

1. Prepare base case scenario

    a) Obtain data from 2031 strategic model (STEM) and *Syme Marmion* report.

    b) Taking *Syme Marmion* figures as base case figures, estimate total number of trips generated by study area (in and out) using standard rates.

    c) Use the 2031 STEM total person trip outputs to distribute these figures throughout Perth (to within Study Area, rest of Stirling and rest of Metropolitan Area).

d) Use the 2031 STEM mode share percentage outputs by area and apply to the distributed trips above.

e) Split the study area into precincts (Stirling Retail Centre, Stirling Station, Rest of Stirling Central, Glendalough Station, Rest of Glendalough Station, and Osborne Park).

f) Allocate trips within study area into precincts pro-rata by geographic area of each precinct.

g) Make assumptions on which O/D trip pairs are likely to use the LRT system as all or part of a PT trip and allocate those PT trips to LRT. For example, a trip from External to Stirling Station precinct is not likely to use LRT (as within walking distance of the train station) but a trip to Osborne Park probably will (as it's outside walking distance from the station).

2. Test alternative scenarios by modifying base case. Scenarios to be tested are:

a) Phase 1 tram only

b) increased development within study area

c) increased PT mode share

d) alternative retail-related trip behaviour.

The remainder of this report describes these steps in more detail and provides details of the results.

4. Base case demand estimation

4.1 Source data

4.1.1 Demographic assumptions

STEM contains standard Metropolitan Land Use Forecast (MLUF) 2031 data on population and employment (Table 4-1).

Table 4-1: Demographics in STEM model (MLUF 2031)

Zone	Population (persons)	Employment (jobs)
Stirling Central	2615	6,909
Osborne Park and part Glendalough	nil	20,688

For this assessment, mid-range development projections from the Syme Marmion report have been adopted as representing a reasonable base case. Population and employment figures from the Syme Marmion report are reproduced in Table 4-2.

Table 4-2: Base case population and floorspace projections

Location	Population	Retail GFA	Office GFA	Industry GFA	Jobs
Osborne Park	0	195,000	0	900,000	11,000
Glendalough	7,000	4000	275,000	0	11 150
Stirling retail core	500	135,000	2,000	0	4 500
Stirling central	16,000	5,000	250,000	0	10 000

These figures show that STEM model data is in line with current thinking for Osborne Park, but that the population and employment figures for Stirling Central are now significantly higher than those included in the model.

Data from STEM was provided in a LGA – LGA matrix of total person trips and total PT trips (for an average weekday). Data for the City of Stirling LGA was split into study area (Stirling Central + Osborne Park[1]) and the remainder of the City of Stirling.

Table 4-3: STEM 2031 all trips summary

Origin Destination:	Study area	Stirling Remainder	Rest of metro area	Total
Study area	34,089	41,554	35,885	111,528
City of Stirling Remainder	41,511	444,968	250,236	736,715
Rest of metro area	35,865	250,345	6,761,523	7,047,733
Total	111,465	736,867	7,047,644	7,895,976

[1] *Approximately ¼ of the Glendalough area is incorporated. For this assessment, 'internal' study area distribution is also applied to Glendalough*

Table 4-4: STEM 2031 PT trips summary

Origin Destination:	Study area	City of Stirling Remainder	Rest of metro area	Total
Study area	1,167	2,747	6,072	9,986
City of Stirling Remainder	2,741	15,561	36,557	54,859
Rest of metro area	6,070	36,607	538,816	581,493
Total	9,978	54,915	581,445	646,338

This results in a mode share table as Table 4-5 below.

Table 4-5: STEM 2031 PT mode share summary

Origin Destination:	Study area	City of Stirling Remainder	Rest of metro area	Total
Study area	3%	7%	17%	9%
City of Stirling Remainder	7%	3%	15%	7%
Rest of metro area	17%	15%	8%	8%
Total	9%	7%	8%	8%

While the *absolute number* of trips under the current scenario are likely to be significantly higher than those predicted by STEM, it is reasonable to assume that the *mode share* across the sectors will be appropriate as a base case. However, the PT mode share shown here for PT for trips internal to the study area (3%) appears low. It is possible that the different type of urban environment and travel behaviour for a tram-based system (as compared to the current car-based development) may show very different behaviour. This is tested later in Scenario 4.

4.1.2 Trip distribution

Analysis of the STEM data shows trips to be distributed symmetrically as in the tables below. It shows that the study area is expected to be around 31% self-contained in trips, and a further 37% of trips from the study area are expected to be destined for other parts of the City of Stirling.

Table 4-6: STEM 2031 Trip distribution (by origin)

Origin Destination:	Study area	City of Stirling Remainder	Rest of metro area	Total
Study area	31%	6%	1%	1%
City of Stirling Remainder	37%	60%	4%	9%
Rest of metro area	32%	34%	96%	89%
Total	100%	100%	100%	100%

Table 4-7: STEM 2031 Trip distribution (by destination)

Origin Destination:	Study area	City of Stirling Remainder	Rest of metro area	Total
Study area	31%	37%	32%	100%
City of Stirling Remainder	6%	60%	34%	100%
Rest of metro area	1%	4%	96%	100%
Total	1%	9%	89%	100%

For the purposes of this project, these distribution figures have been adopted.

4.2 Method for allocation trips to LRT

STEM PT figures were converted to LRT patronage estimates using a set of assumptions or 'rules'. The basic rules adopted for the base case are as follows:

Trips from outside Stirling

If the destination is within 400 m of either Stirling or Glendalough train stations then the LRT will not be used, otherwise the LRT will be used.

Trips from within the Stirling Central study area

If the origin is within 400 m of either of either Stirling or Glendalough train stations then the LRT will not be used, otherwise the LRT will be used (This assumes that the LRT will always be more desirable than the bus system for trips within the study area. As a rough guide, this appears a plausible scenario).

Trips from the remainder of the City of Stirling

(i) Trips to Stirling Central precinct *won't* use LRT, as it is assumed that local area buses will run through the study area to both the train station and shopping centre.

(ii) Trips to Osborne Park precinct will use LRT, as it is assumed that local area buses will either terminate at Glendalough train station or will travel to Stirling precinct.

(iii) Trips from Scarborough Beach and Scarborough Beach Road west of Innaloo won't use the LRT, as it is assumed that the 400 series bus will continue to run from at least Glendalough. The impact of a forced change from bus to LRT at Innaloo would need to be modelled explicitly.

Refer Table 4-8 for detailed matrix.

Note that the key assumption here is that all PT passengers that would use a bus under the STEM model will instead use the LRT. For trips between Osborne Park and Stirling Remainder there are likely to be some trips which continue to use local bus services which would directly link the areas. For this reason, a 25% reduction in LRT trips has been included for this origin-destination pair. More detailed modelling with finer grained geographic areas and transport networks would be needed to test this assumption further.

Table 4-8: Assumed use of LRT for trips assigned to public transport

Origin Destination	Stirling Station	Stirling Retail Centre (Innaloo)	Stirling Central Remainder	Glendalough Station	Osborne Park	Glendalough Remainder	Stirling Remainder	Rest of metro area
Stirling Station	LRT	LRT	LRT	Train	LRT	Train	Bus	Bus/Train
Stirling Retail Centre (Innaloo)	LRT	LRT	LRT	LRT	LRT	Train+LRT	Bus	Bus/Train + LRT
Stirling Central Remainder	LRT	LRT	LRT	LRT	LRT	Train+LRT	Bus	Bus/Train + LRT
Glendalough Station	Train	LRT	LRT	LRT	LRT	Bus	Bus/Train	Train
Osborne Park	LRT	LRT	LRT	LRT	LRT	LRT	Bus + LRT	Bus/Train + LRT
Glendalough Remainder	Train	LRT	LRT	LRT	LRT	Bus	Bus	Bus/Train
Stirling Remainder	Bus	Bus	Bus	Bus	LRT + Bus	Bus	Bus	Bus/Train
Rest of metro area	Train/Bus	LRT + Train/Bus	LRT + Train/Bus	Train/Bus	LRT + Train/Bus	Train/Bus	Bus/Train	Bus/Train

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4.3 Calculations

4.3.1 Trip generation

Trip generation rates shown in Table 4-9 below have been adopted. These are based on the RTA *Guide to traffic generating developments* which is a standard commonly used across Australia. These provide guidance on typical number of car trips generated by a range of land uses on an average weekday. As the RTA figures are for car traffic, the rates have been increased by 10% to allow for trips by modes other than car.

Table 4-9: Trip generation factors

Category	Unit	Rate
Population	Person	3.75
Industrial	100m2	5.5
Office	100m2	11
Retail – small (e.g. convenience stores)	100m2	132
Retail – medium (e.g. small shopping centres)	100m2	86
Retail – large (e.g. bulky goods, major shopping centres)	100m2	55

Following discussions with the City of Stirling, for calculation purposes it was assumed that 1/3 of Osborne Park retail would be small and 2/3 medium sized retail. Stirling Retail Core (primarily Westfield Innaloo) was assumed to be large retail and retail in the remainder of the study area small.

Applying these rates to the base data supplied results in a total of 478, 765 trips generated. Almost half of these are generated by Osborne Park, around one-third from Stirling Central and the remainder from Glendalough (see Table 4-10). The very high trip generation rate in Osborne Park reflects the large amount of retail activity. Many of these trips would be relatively short, for example office workers visiting a lunch bar.

Table 4-10: Trips generated (2031 base case)

Precinct	Total trips Generated
Osborne Park	246540
Stirling Central	170445
Glendalough	61780
Study area total	478765

4.3.2 Trip distribution

Noting that on an average weekday the number of trips is approximately to equal the number of trips out, the total trips generated can be halved to produce origin/destination totals.

4.3.3 External splits

Applying the split factors from Table 4-6 and Table 4-7, Origin-Destination figures are obtained (Table 4-11).

Rounded to the nearest hundred, we find that of the 239,400 trips destined for locations within the study area:

- 73,200 originate from within the study area
- 89,200 originate from the remainder of the City of Stirling outside the study area
- 77,000 originate from elsewhere in the metropolitan area.

Trips in the reverse direction mirror the above.

Table 4-11: Estimated origin-destination trips (2031 base case) – average weekday

Origin Destination:	Study area	Stirling Remainder	Rest of metro area	Total
Study area	73200	89200	77000	239400
Stirling Remainder	89200			
Rest of metro area	77000			
Total	239400			

(Trips wholly outside the study area have not been calculated)

4.3.4 Internal allocation of study area trips

STEM zones are coarse and the study area consists of two zones in the model. These were aggregated to one zone in the output data spreadsheets provided by the Department of Planning. Syme Marmion projections were also provided for two areas only (Stirling Central and Osborne Park) plus surrounding areas.

To support the distribution of trips to the LRT (in accordance with Section 4.2 above) further disaggregation of data into smaller 'precincts' was necessary:

- Stirling Central would be split into a retail precinct, a station precinct and a remainder precinct.
- Glendalough would be split into a station precinct and a remainder precinct
- Osborne Park would remain unsplit.

Refer to Figure 4-1 for map of precincts.

'Stirling Retail' precinct was developed to cover Westfield Innaloo/Innaloo Megacentre sites, which was assumed would continue to be the main retail precinct. The majority of retail and small quantity of commercial and residential GFA forecast for Stirling Central was allocated to this precinct. The remaining GFA was then split between 'Stirling Station' and 'Stirling Central Remainder'. The distribution was done proportionally by geographic area, with all land within 400 m radius of Stirling Station being allocated to the Stirling Station precinct and the remainder to Stirling Central Remainder, with the assumption that land uses would be effectively uniform throughout.

Glendalough was similarly split into Glendalough Station and Glendalough, the remainder by proportioning all uses by geographic area.

The end result of this process was the apportionment of the trips generated by the study area to six precincts. The resulting number and proportion of total trips for each precinct is shown in Table 4-12 below.

Table 4-12: Study area generated trips by precinct

Precinct	Trips generated	%
Osborne Park	246540	51%
Stirling Retail Centre	76345	16%
Glendalough Station	13888	3%
Stirling Station	15294	3%
Rest of Glendalough	47892	10%
Rest of Stirling Central	78806	16%
Total	478765	100%

The previously generated Origin-Destination matrix (Table 4-11) was then split using these precinct proportions. The final precinct-by-precinct Origin-Destination matrix is shown in Table 4-13.

Table 4-13: Estimated total trips OD matrix (incorporating precinct area splits)

Origin / Destination		Stirling Station	Stirling Retail Centre (Innaloo)	City of Stirling Central Remainder	Glendalough Station	Osborne Park	G'lough Remain	Stirling Remainder	Rest of metro area
Internal split (where applicable)		3%	16%	16%	3%	51%	10%		
Stirling Station	3%	100	400	400	100	1200	200	2800	2500
Stirling Retail Centre (Innaloo)	16%	400	1900	1900	300	6000	1200	14200	12300
Stirling Central Remainder	16%	400	1900	2000	300	6200	1200	14700	12700
Glendalough Station	3%	100	300	300	60	1100	200	2600	2200
Osborne Park	51%	1200	6000	6200	1100	19400	3800	45900	39700
Glendalough Remainder	10%	200	1200	1200	200	3800	700	8900	7700
City of Stirling Remainder		2800	14200	14700	2600	45900	8900		
Rest of metro area		2500	12300	12700	2200	39700	7700		

4.3.5 Mode share allocation

Applying mode share table (Table 4-5) to the origin-destination matrix (Table 4-13) we get the estimated PT patronage as shown in Table 4-14: below. This shows the predicted number of trips by public transport between each origin-destination pair. (Trips wholly outside the study area are not considered.)

Table 4-14: Estimated future PT patronage (2031) – average weekday

Origin / Destination	Stirling Station	Stirling Retail Centre (Innaloo)	Stirling Central Remainder	Glendalough Station	Osborne Park	G'lough Remaind	City of Stirling Remainder	Rest of metro area
Stirling Station	3	14	14	3	41	7	185	423
Stirling Retail Centre (Innaloo)	14	65	65	10	205	41	939	2081
Stirling Central Remainder	14	65	68	10	212	41	972	2149
Glendalough Station	3	10	10	2	38	7	172	372
Osborne Park	41	205	212	38	664	130	3034	6718
Glendalough Remainder	7	41	41	7	130	24	588	1303
City of Stirling Remainder	185	938	971	172	3031	305		
Rest of metro area	423	2082	2149	372	6719	264		

Allocation of PT trips to tram is through a 'logic table' (Table 4-15). This indicates whether or not PT trips for each origin/destination pair are likely to use the tram or not. Trips between Stirling Remainder and Osborne Park have been adjusted downwards by 25% as it is assumed that some through services will continue to be provided.

Table 4-15: Allocation of Public Transport Trips Logic Table

Origin / Destination	Stirling Station	Stirling Retail Centre (Innaloo)	Stirling Central Remainder	Glendalough Station	Osborne Park	G'lough Remaind	Stirling Remainder	Rest of metro area
Stirling Station	1	1	1	0	1	0	0	0
Stirling Retail Centre (Innaloo)	1	1	1	1	1	1	0	1
Stirling Central Remainder	1	1	1	1	1	1	0	1
Glendalough Station	0	1	1	1	1	0	0	0
Osborne Park	1	1	1	1	1	1	0.75	1
Glendalough Remainder	0	1	1	1	1	0	0	0
Stirling Remainder	0	0	0	0	0.75	0	0	0
Rest of metro area	0	1	0	0	1	0	0	0

4.4 Summary of findings

The calculations outlined above indicate:

- total trips in study area (all modes, average weekday): 478,765
- trips allocated to tram: 26,751 (approx 5.5% of all trips).

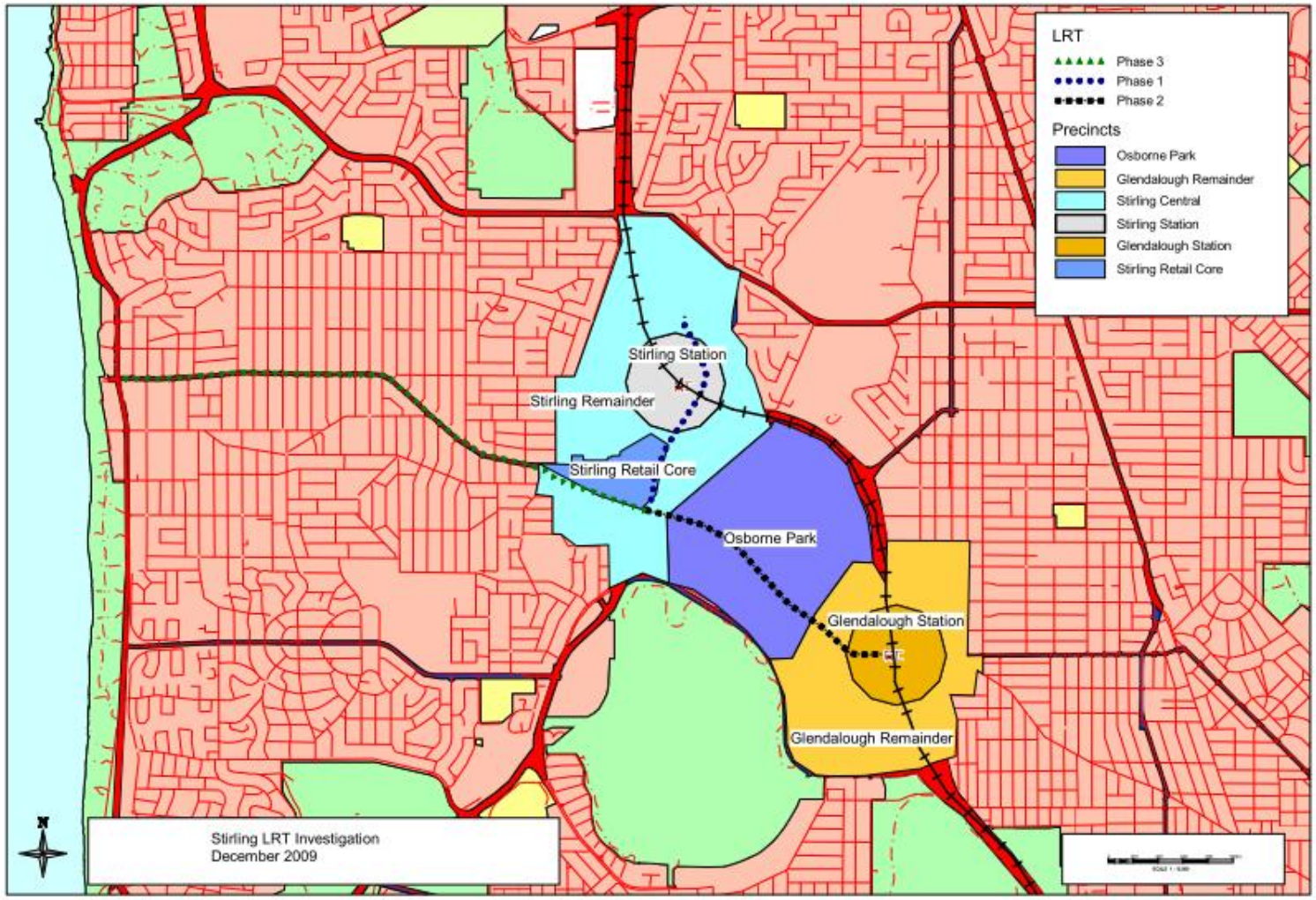

Figure 4-1: Study Precincts

5. Alternative scenarios

5.1 Scenario 2 (Phase 1 tram only)

5.1.1 Description

In this scenario the tram is constructed between Stirling Station and Innaloo (at Scarborough Beach Road) only. All other parameters remain the same as for the base case.

The relevant 'logic' table for allocation of PT trips to the LRT system is as below. Essentially, the tram would only be used for trips within Stirling Central/Stirling Retail precincts and to connect these two precincts to Stirling Station for access to the remainder of the metropolitan area.

Table 5-1: Allocation of Public Transport Trips Logic Table

Origin / Destination	Stirling Station	Stirling Retail Centre (Innaloo)	Stirling Central Remainder	Glendalough Station	Osborne Park	Glen Remainder	Stirling Remainder	Rest of metro area
Stirling Station	1	1	1	0	0	0	0	0
Stirling Retail Centre (Innaloo)	1	1	1	0	0	0	0	1
Stirling Central Remainder	1	1	1	0	0	0	0	1
Glendalough Station	0	0	0	0	0	0	0	0
Osborne Park	0	0	0	0	0	0	0	0
Glen Remainder	0	0	0	0	0	0	0	0
Stirling Remainder	0	0	0	0	0	0	0	0
Rest of metro area	0	1	0	0	0	0	0	0

5.1.2 Findings

Not surprisingly, a very low number of trips by LRT was estimated for this scenario:

Total trips in study area (all modes, average weekday): 478,765 Trips allocated to tram: 6,364 (1.3% of trips)The intent of the initial operating system investigation has taken a "top down" approach to assess opportunities to maximum both development potential and ridership in Phase 1 while creating the foundation for a long term, integrated transit system. The following analysis has considered current bus patronage within the study area to provide a base load condition and assist in understanding current drivers of patronage.

The existing Circle Route travels along this general alignment. In order to isolate the existing demand for this segment of the route we have drawn on the earlier Stirling Regional Centre Structure Plan Transport Review (SKM 2007) which indicates there are approximately 7500 passenger movements per day in the area. However, these trips are dispersed to all areas. As indicated in bold in Table 5-2, the area that tram Phase 1 would cover (i.e., between Innaloo and Stirling) is estimated to be only in the order of 430 trips per day in 2007.

Table 5-2: Allocation of 2007 Public Transport Trips

Location and direction	Month	Average day
Flows potentially replaced by tram phases 1 / 2		
Innaloo towards Glendalough	3,000 (phase 2 only)	120
Innaloo towards Stirling Station	**4,330**	**175**
Innaloo (cinemas) towards Stirling	**1,025**	**41**
Flows not replaced by Tram		
Innaloo towards Scarborough Beach or Churchlands	7,413	300
Innaloo towards Churchlands and/or Osborne Park industrial	2,500	100
Innaloo (cinemas) towards Churchlands	1,500	60
(for reference)		
Stirling station Circle Line anticlockwise (to Innaloo, Churchlands and beyond)	17,609	700
Stirling station to everywhere else	46,983	1,880

Note: double this number for two-way trips

Taking these figures, it can be seen that on an average weekday there are around (175+41) x2 = 432 passengers boarding or alighting buses in Innaloo to or from the Stirling Station direction.

This broad analysis indicates that there is a need to consider carefully the proposed alignment of the LRT and opportunities for refinement to maximise patronage potential.

As an observation, any decision on whether or not to construct Phase 1 of the LRT would not be justified by patronage alone. Rather, Phase 1 of the line should be used as a catalyst for development within the Stirling Central area to help encourage the preferred patterns of development. In this role, Stage One must be tied to commitments to develop transit supportive land uses within an acceptable timeframe and firm agreements should be in place to adequately cover operating costs. In addition, under this scenario, Stage One should only proceed if there is certainty that the full system will be built to ensure a more financially sustainable outcome.

AAs this figure is low, any decision on whether or not to construct Phase 1 of the LRT would not be justified by patronage alone. Rather, Phase 1 of the line should be used as a catalyst for development within the Stirling Central area to help encourage the preferred patterns of development. In this role, Stage One must be tied to commitments to develop transit supportive land uses within an acceptable timeframe and firm agreements should be in place to adequately cover operating costs. In addition, under this scenario, Stage One should only proceed if there is certainty that the full system will be built to ensure a more financially sustainable outcome

5.2 Scenario 3 (increased land use development)

5.2.1 Description

Discussions with the City of Stirling indicated that the Syme Marmion demographic projections were lower than the City of Stirling aspirations for the area. The major differences were

- addition of 5000 residents to Osborne Park (anticipated as residential development within the Herdsman Business Park area south of Scarborough Beach Road)
- additional 5000 jobs in the Glendalough area
- additional 10000 jobs in the Stirling Central area.

To test these alternative scenario, a matching demographics forecast was developed. Total jobs were increased by adjusting Office GFA figures to until the number of jobs approximated targets. An employee density of 25.5 m^2 per employee was applied, as per the Syme Marmion research. Population targets were directly entered. No change was made to the retail of industrial components. The final figures used are shown in Table 5-3.

Table 5-3: Alternative (aspirational) population and floorspace figures

Location	Pop	Retail GFA	Office GFA	Industry GFA	Jobs [1]
Osborne Park	5000	195000	0	900000	11000
Glendalough Frame	7000	4000	0	0	150
Glendalough Office	3000	0	375000	0	15000
Stirling Retail Core	5000	135000	2000	0	4500
Stirling Central	25000	5000	500000	0	20000
Glendalough Remainder	7000	3500	0	0	100

5.2.2 Findings

Under this scenario, a total of 597,890 trips were found to be generated (4). Of these 30,991 were expected to use the LRT. This represents a mode share of 5.2% of all trips.

Table 5-4: Scenario 3 (alternative land use) total trips

Origin / Destination	Study area	Stirling Remainder	Rest of metro area	Total
Study area	91,400	111,400	96,200	298,900
Stirling Remainder	111300			
Rest of metro area	96200			
Total	298900			

5.3 Scenario 4 (increased PT mode share)

5.3.1 Description

It was noted that the mode share determined by the STEM model for public transport trips within the study area was low at 3%. Research suggested that a higher mode share for public transport would be expected in the different (higher density, mixed use) environment envisaged for Stirling Central in the future. Planning work undertaken by the City of Stirling indicated that a mode share to PT for all trips of around 15% would be desirable to avoid traffic gridlock. Walking and cycling would also undertake a more significant role.

A review of published data for the Melbourne area showed that inner city municipalities well served by the tram system achieved PT mode shares of between 14% and 17% (refer Table 5-5).

Table 5-5: Transport mode share in inner Melbourne (2007)

Mode	Port Phillip	Yarra	Melbourne
Car/Motorcycle	54.2	49.9	35.0
Public Transport	14.0	15.6	16.8
Walk/Cycle/Other	31.9	40.6	48.2

With these points in mind, a scenario was tested in which public transport mode share for internal trips was significantly boosted to match Melbourne experience and City of Stirling aspirations. The relevant mode share table is Table 5-6.

Table 5-6: Mode share - increased PT mode share scenario

Origin / Destination	Study area	Stirling Remainder	Rest of metro area	Total
Study area	15%	15%	17%	16%
Stirling Remainder	15%			
Rest of metro area	17%			
Total	16%			

5.3.2 Results

The results of this test showed a significant (25%) increase in tram trips. Of the total of 478,765 trips, 40,825 would be allocated to the LRT. This represents a mode share of 8.5% of all trips. The remainder of PT trips would be either train or bus to either Glendalough or Stirling stations.

5.4 Scenario 5 (alternative retail patterns, Osborne Park)

5.4.1 Description

During the development of the base case it was noticed that a significant proportion of trips to and within the study area was associated with retail development. RTA and other guidelines note that the number of trips generated by retail establishments vary considerably depending both on the type of store (e.g. supermarket vs specialty store) but also on the context (e.g. shopping mall vs stand-alone).

In the land use projections there is a large allocation of retail space to Osborne Park, outside of the designated retail core. Currently Osborne Park features a large component of bulky goods, car dealerships and other similar low intensity retail. Under the base case scenario it is assumed that there will be a significant conversion of uses, with a greater intensity of use including 'main street' type retail activities. For trip generation purposes, 1/3 was allocated to small (high trip generation) retail and 2/3 to medium size (moderate trip generation) purposes.

It is possible that the conversion will be less intense and that more bulky goods and showroom activities will remain. To test this scenario a lower trip generation rate is appropriate. Rates have been dropped to 1/3 medium size and 2/3 low trip generation. All other parameters remain as per base case.

5.4.2 Findings

The origin-destination total trip matrix for this scenario is shown in Table 5-7 below.

Table 5-7: Trips by origin and destination - alternative retail rates

Origin / Destination	Study area	Stirling Remainder	Rest of metro area	Total
Study area	60,500	73,700	63,700	197,900
Stirling Remainder	73,700			
Rest of metro area	63,700			
Total	197,900			

Overall the small change in retail generation rates for one precinct had a noticeable impact on total trip numbers (a 17% drop). The impact on tram patronage was even stronger (20% drop):

- total trips in study area (all modes, average weekday): 395,856
- trips allocated to tram: 21,307.(5.3% of all trips).

This clearly shows the sensitivity of the transport demand to the retail environment.

6. Summary and conclusions

This study has examined potential patronage of a light rail system to support the Stirling – Osborne Park region of the City of Stirling in Perth. This study has been triggered by the desire of the City of Stirling and the WA Planning Commission to redevelop the Stirling City Centre into a major urban centre incorporating significant new commercial, retail, community and residential opportunities. At the same time, studies are underway to review the major Scarborough Beach Road corridor through Osborne Park. The total would represent a fundamental change in the nature of the area from one dominated by a major shopping mall, warehouses and bulky goods retail to a city centre featuring 24/7 activity.

Previous work undertaken by the Stirling City Centre alliance indicated that the road network would not be capable of handling the proposed increase in activity without a major shift to other transport modes, including public transport. An LRT has been proposed as one method of accommodating the required transport demand while at the same time providing an 'anchor' to encourage the type and level of development intended.

In addition to the real estate development catalyst role, a key role for the light rail will be to link people to the rail system at Stirling and Glendalough Stations. It will be critical to the success of the transport system in meeting the mode share targets for the Regional Centre that this distributor function work effectively by providing a seamless connection to the rail and bus networks which provide the links to the wider metropolitan area. Given the fact that the majority of people will be accessing destinations which are outside reasonable walking distance of the railway stations LRT is well suited to serving this distributor role.

Street running systems (trams) are primarily designed as local area circulators, not to serve long haul commuter trips. Along LRT corridors, station spacing is typically within relatively close proximity allowing the LRT to serve as a 'pedestrian accelerator.' It can also be described as a 'horizontal elevator', similar to a multi-floor department store, with a different purpose or function at each station. A well designed LRT route will show good two-way patronage throughout the day as it supports multiple uses, such as shopping during the day and leisure trips after hours as well as commuter trips during the peaks.

In this study of a potential LRT, the base case analysis showed an estimated light rail patronage of approximately 27,000 trips on an average weekday. Increasing development to the higher 'aspirational' levels would increase this somewhat to approximately 31,000 trips, while if the travel behaviour changed to that more like typical tram served locations (inner Melbourne) as many as 41,000 trips per day might be expected.

These figures were found to be very sensitive to changes in shopping related trips and trip behaviour, as was shown by the test results of reducing the retail trip generation rate for the Osborne Park area. It is worth noting that the patronage estimation included in the Syme Marmion report likely underestimates retail trips significantly, as their estimate considers only trips by householders and inbound work trips.

The importance of Osborne Park and Glendalough areas is further highlighted by the testing of a Phase 1 tram route only. This returned a much lower estimate of patronage (around 6,000) trips.

The findings of each scenario are summarised in Table 6-1, below.

Table 6-1: Summary of findings by scenario

	Base case	Phase 1 tram only	Increased development	Improved PT mode share	Reduced retail intensity (O.Pk)
Total trips	479,000	479,000	598,000	479,000	396,000
Tram trips	27,000	6,000	31,000	41,000	21,000

To place these findings in context, comparison can be made with light rail systems introduced in recent years in the United States (see Table 6-2 below). Comparison with these figures indicates that the Stirling light rail system is definitely 'in the ballpark'.

Phase 1 would almost certainly not be justified on patronage grounds alone over the short term. However as a development catalyst it displays some merit. This study suggests that Phase 1 and 2 together would probably generate significant levels of associated development and patronage provided that there is 'buy in' from land holders and developers in the corridor.

Alternatively, Phase 1 of the line should be used as a catalyst for development within the Stirling Central area to help encourage the preferred patterns of development. In this role, Phase 1 must be tied to commitments to develop transit supportive land uses within an acceptable timeframe and firm agreements should be in place to adequately cover operating costs. In addition, under this scenario, Phase 1 should only proceed if there is certainty that the full system will be built to ensure a more financially sustainable outcome.

In addition, further investigation should be conducted to refine the initial operating segment or extent of Phase 1. Minor changes in the segment may benefit the ridership by linking existing or near term destinations, a critical characteristic of successful LRTs. In other words, the initial operating segment of the LRT should connect 'somewhere' to 'somewhere' to foster ridership and to catalyse development. The segment should not be based on right of way availability as the primary factor, but on the connection of destinations and the frontage on development sites.

Table 6-2: Daily patronage, selected US LRT routes

City	Line	Patronage (daily)
Houston, Texas	Metro red line (7.5 mi)	40,000
San Diego, California	Green line (5.9 mi)	27,000
Minneapolis, Minnesota	Hiawatha Line (12 mi)	30,100
Portland, Oregon	Yellow Line (5.8 mi)	13,600
Sacramento, California	South Corridor (6.3 mi)	9,250

On these results, further detailed study of the proposed LRT appears warranted. This study should consider not only patronage in more detail, but also review the ability of an LRT to shape and support the type, level and location of urban development desired. It should also consider the requirements for effective integration with the rail and bus networks and address any potential issues relating spatial needs and co-location of with other modes.